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A Survey on Face Detection Technology Using Digital Image Processing

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ABSTRACT: A face recognition technology is used to automatically identify a person through a digital image. It is mainly used in security systems. The face recognition will directly capture information about the shapes of faces. The main advantage of facial recognition is it identifies each individual's skin tone of a human face's surface, like the curves of the eye hole, nose, and chin, etc. this technology may also be used in very dark condition. It can view the face in different angles to identify. When compared with other biometrics systems using fingerprint and iris, face recognition has different advantages because it is without touching the person. Trough Face images we can capture the person identification from a distance without touching or interacting with them. This report develops a socio-political analysis that bridges the technical and social-scientific literatures on FRT and addresses the unique challenges and concerns that attend its development, evaluation, and specific operational uses, contexts, and goals. It highlights the potential and limitations of the technology, noting those tasks for which it seems ready for deployment, those areas where performance obstacles may be overcome by future technological developments or sound operating procedures, and still other issues which appear intractable. Its concern with efficacy extends to ethical considerations.

I. INTRODUCTION

The information age is quickly revolutionizing the way transactions are completed. Everyday actions are increasingly being handled electronically, instead of with pencil and paper or face to face. This growth in electronic transactions has resulted in a greater demand for fast and accurate user identification and authentication. Access codes for buildings, banks accounts and computer systems often use PIN's for identification and security clearances.

Using the proper PIN gains access, but the user of the PIN is not verified. When credit and ATM cards are lost or stolen, an unauthorized user can often come up with the correct personal codes. Despite warning, many people continue to choose easily guessed PIN's and passwords: birthdays, phone numbers and social security numbers. Recent cases of identity theft have highten the need for methods to prove that someone is truly who he/she claims to be.

Face recognition technology may solve this problem since a face is undeniably connected to its owner expect in the case of identical twins. Its nontransferable.

I.I *What is Face Recognition?*

Face recognition technology is the least intrusive and fastest biometric technology. It works with the most obvious individual identifier – the human face.

Instead of requiring people to place their hand on a reader(a process not acceptable in some cultures as well as being a source of illness transfer) or precisely position their eye in front of a scanner, face recognition systems unobtrusively

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take pictures of people's faces as they enter a defined area. There is no intrusion or delay, and in most cases the subjects are entirely unaware of the process. They do not feel "under surveillance" or that their privacy has been invaded.
For face recognition there are two types of comparisons .the first is verification. This is where the system compares the given individual with who that individual says they are and gives a yes or no decision. The second is identification. This is where the system compares the given individual to all the other individuals in the database and gives a ranked list of matches.

All identification or authentication technologies operate using the following four stages:

- Capture: A physical or behavioral sample is captured by the system during enrollment and also in identification or verification process
- Extraction: unique data is extracted from the sample and a template is created.
- Comparison: the template is then compared with a new sample.
- Match/non match: the system decides if the features extracted from the new samples are a match or a non match

Face recognition technology analyze the unique shape, pattern and positioning of the facial features. Face recognition is very complex technology and is largely software based. Face recognition starts with a picture, attempting to find a person in the image. This can be accomplished using several methods including movement, skin tones, or blurred human shapes.

The face recognition system locates the head and finally the eyes of the individual. A matrix is then developed based on the characteristics of the individual's face. The method of defining the matrix varies according to the algorithm (the mathematical process used by the computer to perform the comparison). This matrix is then compared to matrices that are in a database and a similarity score is generated for each comparison.

There are essentially two methods of capture. One is video imaging and the other is thermal imaging.

Video imaging is more common as standard video cameras can be used. The precise position and the angle of the head and the surrounding lighting conditions may affect the system performance. The complete facial image is usually captured and a number of points on the face can then be mapped, position of the eyes, mouth and the nostrils as a example. More advanced technologies make 3-D map of the face which multiplies the possible measurements that can be made.

Thermal imaging has better accuracy as it uses facial temperature variations caused by vein structure as the distinguishing traits. As the heat pattern is emitted from the face itself without source of external radiation these systems can capture images despite the lighting condition, even in the dark. The drawback is high cost. They are more expensive than standard video cameras.

I.II *Capturing of image by standard video cameras:*

The image is optical in characteristics and may be thought of as a collection of a large number of bright and dark areas representing the picture details. At an instant there will be large number of picture details existing simultaneously each representing the level of brightness of the scene to be reproduced. In other words the picture information is a function of two variables: time and space. Therefore it would require infinite number of channels to transmit optical information corresponding to picture elements simultaneously. There is practical difficulty in transmitting all information simultaneously so we use a method called scanner.

Here the conversion of optical information to electrical form and its transmission is carried out element by element one at a time in a sequential manner to cover the entire image. A TV camera converts optical information into electrical information, the amplitude of which varies in accordance with variation of brightness.
An optical image of the scene to be transmitted is focused by lens assembly on the rectangular glass plate of the camera tube. The inner side of this has a transparent coating on which is laid a very thin layer of photoconductive material. The photo layer has very high resistance when no light is falling on it but decreases depending on the intensity of light falling on it. An electron beam is formed by an electron gun in the TV camera tube. This beam is used to pick up the picture information now available on the target plate of varying resistance at each point.

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The electron beam is deflected by a pair of deflecting coils mounted on the glass envelope and kept mutually perpendicular to each other to achieve scanning of the entire target area. The deflecting coils are fed separately from two sweep oscillators, each operating at different frequencies. The magnetic deflection caused by current in one coil gives horizontal motion to the beam from left to right at a uniform rate and brings it back to the left side to commence the trace of the next line. The other coil is used to deflect the beam from top to bottom.As the beam moves from

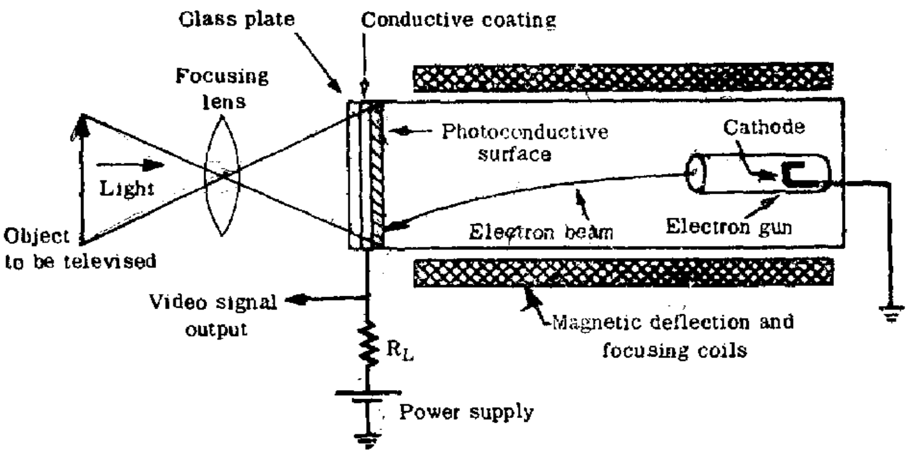

Figure- 1

element to element it encounters different resistance across the target plate depending on the resistance of the photoconductive coating. The result is flow of current which varies in magnitude as elements are scanned. The current passes through the load resistance connected to conductive coating on one side of the DC supply source on the other. Depending on the magnitude of current a varying voltage appears across the resistance Rl and this corresponds to the optical information of the picture.

II.RELATED WORK

Most detection systems carry out the task by extracting certain properties (e.g., local features or holistic intensity patterns) of a set of training images acquired at a fixed pose (e.g., upright frontal pose) in an off-line setting. To reduce the effects of illumination change, these images are processed with histogram equalization [3, 1] or standardization (i.e., zero mean unit variance) [2]. Based on the extracted properties, these systems typically scan through the entire image at every possible location and scale in order to locate faces. The extracted properties can be either manually coded (with human knowledge) or learned from a set of data as adopted in the recent systems that have demonstrated impressive results [3, 1, 4, 5, 2]. In order to detect faces at different scale, the detection process is usually repeated to a pyramid of images whose resolution are reduced by a certain factor (e.g., 1.2) from the original one [3, 1]. Such procedures may be expedited when other visual cues can be accurately incorporated (e.g., color and motion) as pre-processing steps to reduce the search space [5]. As faces are often detected across scale, the raw detected faces are usually further processed to combine overlapped results and remove false positives with heuristics (e.g., faces typically do not overlap in images) [1] or further processing (e.g., edge detection and intensity variance).
Numerous representations have been proposed for face detection, including pixel-based [3, 1, 5], parts-based [6, 4, 7], local edge features [8, 9], Haar wavelets [10, 4] and Haar-like features [2, 11]. While earlier holistic representation schemes are able to detect faces [3, 1, 5], the recent systems with Haar-like features [2, 12, 13] have demonstrated impressive empirical results in detecting faces under occlusion. A large and representative training set of face images is

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essential for the success of learning-based face detectors. From the set of collected data, more positive examples can be synthetically generated by perturbing, mirroring, rotating and scaling the original face images [3, 1]. On the other hand, it is relatively easier to collect negative examples by randomly sampling images without face images [3, 1].
As face detection can be mainly formulated as a pattern recognition problem, numerous algorithms have been proposed to learn their generic templates (e.g., eigenface and statistical distribution) or discriminant classifiers (e.g., neural networks, Fisher linear discriminant, sparse network of Winnows, decision tree, Bayes classifiers, support vector machines, and AdaBoost). Typically, a good face detection system needs to be trained with several iterations. One common method to further improve the system is to bootstrap a trained face detector with test sets, and re-train the system with the false positive as well as negatives [1]. This process is repeated several times in order to further improve the performance of a face detector. A survey on these topics can be found in [5], and the most recent advances are discussed in the next section.

III. COMPONENTS OF FACE RECOGNITION SYSTEMS :

- An automated mechanism that scans and captures a digital or an analog image of a living personal characteristics.(enrollment module).
- Another entity which handles compression, processing, storage and compression of the captured data with stored data (database).
- The third interfaces with the application system (identification module)

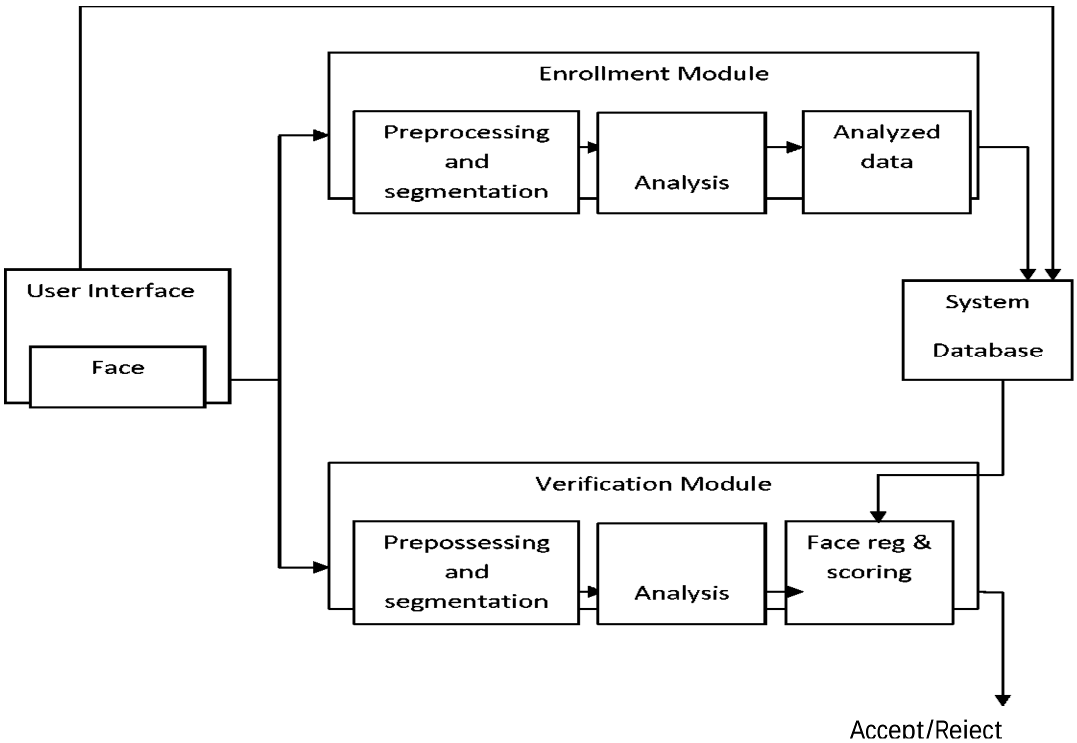

Figure:2

User interface captures the analog or digital image of the person's face. In the enrollment module the obtained sample is preprocessed and analyzed. This analyzed data is stored in the database for the purpose of future comparison.

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The database compresses the obtained sample and stores it. It should have retrieval property also that is it compares all the stored sample with the newly obtained sample and retrieves the matched sample for the purpose of verification by the user and determine whether the match declared is right or wrong.

The verification module also consists of a preprocessing system. Verification means the system checks as to who the person says he or she is and gives a yes or no decision. In this module the newly obtained sample is preprocessed and compared with the sample stored in the database. The decision is taken depending on the match obtained from the database. Correspondingly the sample is accepted or rejected.

Instead of verification module we can make use of identification module. In this the sample is compared with all the other samples stored in the database. For each comparison made a match score is given. The decision to accept or reject the sample depends on this match score falling above or below a predetermined threshold.

IV. IMPLEMENTATION OF FACE RECOGNITION TECHNOLOGY

The implementation of face recognition technology includes the following four stages:

- Data acquisition
- Input processing
- Face image classification and decision making

III.I *Data acquisition:*

The input can be recorded video of the speaker or a still image. A sample of 1 sec duration consists of a 25 frame video sequence. More than one camera can be used to produce a 3D representation of the face and to protect against the usage of photographs to gain unauthorized access.

III.II *Input processing:*

A pre-processing module locates the eye position and takes care of the surrounding lighting condition and colour variance. First the presence of faces or face in a scene must be detected. Once the face is detected, it must be localized and

Normalization process may be required to bring the dimensions of the live facial sample in alignment with the one on the template.

Some facial recognition approaches use the whole face while others concentrate on facial components and/ or regions (such as lips, eyes etc). The appearance of the face can change considerably during speech and due to facial expressions. In particular the mouth is subjected to fundamental changes but is also very important source for discriminating faces. So an approach to person's recognition is developed based on patio- temporal modeling of features extracted from talking face. Models are trained specific to a person's speech articulate and the way that the person speaks. Person identification is performed by tracking mouth movements of the talking face and by estimating the likelihood of each model of having generated the observed sequence of features. The model with the highest likelihood is chosen as the recognized person.

III.III *Face image classification and decision making:*

Synergetic computer are used to classify optical and audio features, respectively. A synergetic computer is a set of algorithm that simulates synergetic phenomena. In training phase the BIOID creates a prototype called faceprint for each person. A newly recorded pattern is preprocessed and compared with each faceprint stored in the database. As comparisons are made, the system assigns a value to the comparison using a scale of one to ten. If a score is above a predetermined threshold, a match is declared. From the image of the face, a particular trait is extracted. It may measure various nodal points of the face like the distance between the eyes ,width of nose etc. it is fed to a synergetic computer which consists of algorithm to capture, process, compare the sample with the one stored in the database. We can also track the lip movement which is also fed to the synergetic computer. Observing the likelihood each of the samples with the one stored in the database we can accept or reject the sample.

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V. APPLICATION

The natural use of face recognition technology is the replacement of PIN, physical tokens or both needed in automatic authorization or identification schemes. Additional uses are automation of human identification or role authentication in such cases where assistance of another human needed in verifying the ID cards and its beholder.

There are numerous applications for face recognition technology:

IV.I *Government Use:*

- Law Enforcement: Minimizing victim trauma by narrowing mugshot searches, verifying
- Identify for court records, and comparing school surveillance camera images to know child molesters.
- Security/Counterterrorism. Access control, comparing surveillance images to Know terrorist.
- Immigration: Rapid progression through Customs.

IV.II *Commercial Use:*

- Day Care: Verify identity of individuals picking up the children.
- Residential Security: Alert homeowners of approaching personnel.
- Voter verification: Where eligible politicians are required to verify their identity during a voting process this is intended to stop 'proxy' voting where the vote may not go as expected.
- Banking using ATM: The software is able to quickly verify a customer's face.
- Physical access control of buildings areas, doors, cars or net access.

VI. CONCLUSION

Face recognition technologies have been associated generally with very costly top secure applications. Today the core technologies have evolved and the cost of equipments is going down dramatically due to the integration and the increasing processing power. Certain applications of face recognition technology are now cost effective, reliable and highly accurate. As a result there are no technological or financial barriers for stepping from the pilot project to widespread deployment.

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